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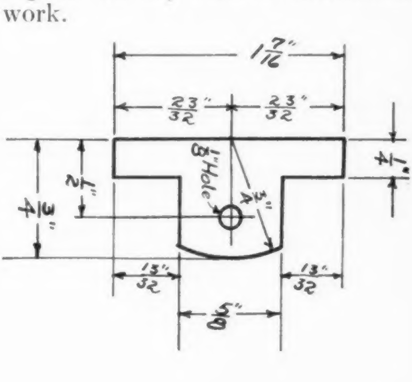
EDITORIALS

We have had a number of inquiries for a binder suitable for holding the copies of "Lubrication". Goldsmith Bros., 77 Nassau Street, New York, have a stock binder No. 125½ for thirty-five cents, to which should be added six cents to cover postage. If there is sufficient demand, we will be glad to have some special binders made with gold lettering, which will cost, including postage, about fifty cents. The binding can be improved by using pressboard, hard cardboard or metal clips as shown in the drawing, putting the clips through a cut in the back of the book.

The importance of the flash and fire tests in connection with lubricating oils is a subject which has been much discussed. Mr. Parish, in his article on Flash and Fire Tests, reprinted in this month's issue, has discussed the subject from a new point of view, having in mind the use of oils in the power cylinders of internal combustion engines. So far as the use of general lubricating oil is concerned, it should be remembered that bearing temperatures seldom exceed 150 degrees F., and a flash test over 300 degrees F. would leave a margin of safety of over 150 degrees. In regard to steam cylinder oil, the fact that there is absolutely no oxygen present in the cylinder and that it would therefore be impossible for a flash to occur seems to indicate that the flash test has practically nothing to do with the suitability of lubricating oils for any class of mechanical work.



FLASH AND FIRE TESTS*

By W. F. Parish
Manager, Lubricating Division, The Texas Company

THE flash point of an oil is that temperature at which, upon being heated, it emits a vapor that will flash upon application of a small flame, and the fire point is the temperature at which the oil, when heated, will ignite and burn on the application of the flame. By some of the technical engineers who from time to time have written upon the general subject of oils, these tests have been considered very important.

Originally flash and fire tests were required in the examination of petroleum products, especially burning oils, in order to prevent oils from being made that, under ordinary storage or working conditions, would cause fires. Very little use is made of these readings in the process of refining oils, as they do not generally act as a guide in standardizing a product. The readings are valuable only in giving assurance that the finished product is uniform and contains none of the lighter distillates that might get into it by accident.

Crude oils vary in the property of giving a high or low flash point to a finished lubricating oil. Paraffin crude from the northern fields of the United States allows of the production of high flash point oil. Oils made in the same manner and having the same physical characteristics, but refined from semi-paraffin crudes from the mid-continental or southern fields do not have as high a flash point, owing to the peculiarity of the crude. Oils made from Russian crude or from the various continental petroleums vary in a like manner, the lowest flash point oils being produced from the Russian crude. In this country what are known as the asphaltic, or the southwestern and western crudes, produce oils of somewhat lower flash point, while, with the exception of gravity, the other physical characteristics, such as body, color and odor of the finished product, might be quite similar to those of oils made from the Pennsylvania crude. Although it is possible to make oils of exactly the same viscosity and color from all of the various crudes mentioned, the flash point of each of the finished oils will vary through a considerable range.

Quite naturally there has always been a considerable effort made by those particularly interested in northern paraffin oils to emphasize the importance of the flash point. In the course of a number of years opinion regarding high flash has undergone a considerable change, owing to the rapid strides made by the refiners of the asphaltic crudes. These refiners have been able to produce from their comparatively low flash crudes unusually fine lubricating oils, which in actual service in internal combustion engines have shown a number of very valuable features. One of these, for instance, is an absence or greatly reduced amount of free carbon in the cylinders, such carbon as there is being of a decidedly different character from that produced by the northern paraffin oil. Further, the oils produced from low flash crudes

* Reprinted, with author's corrections, from the December, 1916, issue of "Motor Boating," p. 34 *et seq.*

do not seem to decompose as rapidly under internal combustion engine conditions. The proof of this lies in the fact that the low flash oils do not leave carbon deposits, and further that they retain their working body for a much longer period—that is, they do not break down under the extremely severe conditions of operation in internal combustion service.

It is interesting, in considering the subject of flash and fire points of oil, to note the development that has taken place from the time of the introduction of the internal combustion engines. Such engines were introduced at a period when steam engine lubrication practice was well developed, and the necessary cylinder oils were being made from so-called Pennsylvania crude, the only crude then available. These oils were compounded and used very widely and with good results for the internal lubrication of the cylinders of steam engines. On account of the nature of the crude from which they were made, and due also to the very heavy viscosity of these oils, they ran from 500 to 650 degrees F. flash point. In considering the lubrication requirements of the first internal combustion engines the engineers estimated the temperature due to explosion of the gas to be very high, probably in the neighborhood of 2,000 degrees F., and they were all of the opinion that this high temperature necessitated a lubricating oil with a high flash point which assumably would not vaporize when placed in the cylinder under high heat conditions.

With hardly an exception, every early internal combustion engine had its power cylinders lubricated with either compounded cylinder oil or high flash cylinder stock; and it was very much regretted by the manufacturers of the engines and the oil men who were interested that they did not have available oils having flash points in the neighborhood of 1,500 degrees F. It was actually considered at that time, as many of the older engineers in the business can remember, that the flash point was the one feature of prime importance.

Owing to the thickness of the cylinder walls and consequent lack of effectiveness of the cooling water, the internal temperatures of the early engines were much greater than those of the present day type, although the temperatures of the explosion would be about the same as at present. Thus the lubrication engineer in the early stages of the gas engine development had a more difficult problem confronting him than we have today.

It developed in the practical work of lubricating these engines that a multitude of difficulties arose, directly traceable to the carbon-forming properties of these heavy cylinder oils when used under high dry heat conditions. In the attempt to prevent recurrence of these troubles, lighter bodied oils were eventually introduced, until the heavier grade engine oils were established almost entirely for this class of work.

During the years that followed the lubricating oil requirements of oil and gasoline engines were being very closely observed, and a great many very interesting experiments were made with oils of all characters. It was found as a general rule that of the oils then available (Pennsylvania and Russian oils), those having a combination of high viscosity with low flash would give unusually good results. Even in the early days of internal combustion engine lubrication operators could be found who would give voice to the then radical statement that an oil was

wanted that would disappear completely when it worked over into the combustion chamber; and that if high flash had anything to do with an oil remaining, so that partial distillation would take place, resulting in coking or carbonizing, high flash was not required for this particular service.

Notwithstanding the occasional light that was given the subject by thoughtful engineers, the commercial interests of the paraffin oil manufacturer influenced him to maintain that high flash was the requisite quality of an oil for the power cylinders of the internal combustion engine. Only a few years back a number of controversies between the advocates of various oils took place in the technical journals, the discussion being practically centered about this very interesting point of the vaporizing temperature of an oil. The field at that time seemed very unequally divided between the advocates of the high and the low flash point oils. The specifications issued by the Society of Automobile Engineers some years ago favored the high flash point principle, and undoubtedly the action of this society influenced the opinion of quite a number of engineers connected with the motor industry, and that may have led to the belief that high flash was of more importance than the facts would seem to indicate.

If we examine the motor oil business in its development during the past ten years we shall get a very good idea as to exactly what has taken place in the minds of the oil manufacturers. After it was definitely decided that cylinder stocks could not be used for internal combustion cylinder lubrication, lighter oils were gradually placed in this service. Finally, in an attempt to overcome carbon difficulties, the oils recommended for this class of work were what are generally known to the trade as heavy spindle oils.

The marketing record of any oil manufacturer will show, as a rule, that the greatest amount of sales are of the lighter bodied oils, these oils in practice generally giving less carbon difficulty. Further, careful examination of all of the various oil manufacturers' recommendations for oil to be used on motor equipment shows that the majority of these recommendations are for the use of their lighter oils. These recommendations are based largely upon experience in lubricating various types and are largely the result of the attempt to eliminate carbon difficulties. The heaviest motor oils of the large companies constitute the smallest proportion of their total sales, which again is proof of the partial elimination of these oils except for unusual requirements, this elimination coming from the fact that trouble of some kind or other has been more or less pronounced with the use of these oils. The heaviest oils on any oil refiner's list are those which are highest in flash, so this seems to dispose of the theory that high flash is the main requirement of a motor oil.

The difficulty met in internal combustion engine lubrication carried on by use of the light oils is the small sealing effect produced by using these oils. An oil cannot produce a seal between the walls of the cylinders and the face of the rings sufficiently tight to prevent leakage of the gasoline mixture during the compression stroke, or to impede the lubricating oil in creeping by the rings during the admission stroke, unless it has sufficient body at working temperatures, combined with other characteristics that are somewhat related to body or viscosity. This

seal requirement should be the boundary line for the lightness of the oil. The "seal" can best be determined by the effect which the leaking gas has upon the lubricating oil in the motor. If, after a hard, short run, the flash test of the motor oil is below 250 degrees F., the indications are that the oil is not producing as good a seal as the engine requires, and a heavier lubricant should be used. The result will be a very small escapement of gas and consequently hardly any lowering of the flash point of the oil. If many such tests are made it will usually be found that the higher the flash point of the new oil, the greater the reduction in flash point after that oil has been used in the motor. It usually transpires that the best seal can be secured by using an oil of suitable body having the lowest flash point procurable, providing the low flash is not the result of an admixture of volatile oils.

THE UNIVERSAL UNAFLOW ENGINE

By A. D. Skinner
Vice-President, The Skinner Engine Company

As was explained in the November issue of "Lubrication," the European unaflow engine was designed primarily for condensing service, as it could be operated condensing only and still retain the small clearance which is necessary to economy. If the engine should operate non-condensing, enough clearance must be provided to prevent the compression from exceeding the boiler pressure.

It therefore follows that the lower the boiler pressure, or the higher the

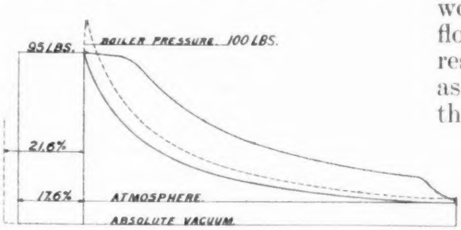


Figure 1

back pressure, the greater the clearance which must be provided. Fig. 1 shows that approximately 17.6 per cent. clearance must be provided in case the boiler pressure is 100 pounds with atmospheric exhaust; and 21.6 per cent. with the same boiler pressure and three pounds back pressure in the exhaust. The excessive amount of clearance of course is detrimental to economy; and, in America, where fully ninety per cent. of the steam engines installed operate non-condensing, it was found that the European unaflow engine would have to be considerably modified.

The engineering force of The Skinner Engine Company had been working on a non-condensing unaflow design for several years, the result being the design now known as the "Universal Unaflow", where the compression is delayed by placing auxiliary exhaust ports at that point in the unaflow cylinder where it is usual to start the compression in a non-condensing counterflow engine.

As is shown in the cross-sectional view of the "Universal Unaflow" cylinder, in Fig. 2, the main exhaust takes place through the central exhaust ports; and the trapped vapor at exhaust pressure, between the

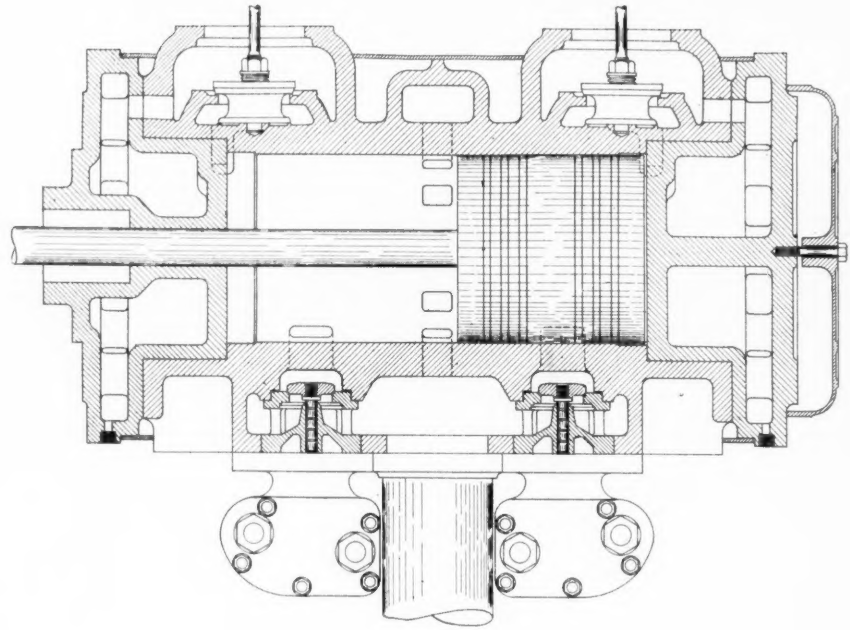


Figure 2

advancing piston (after it has covered the central exhaust ports on its return stroke) and the auxiliary exhaust port, is released through the auxiliary exhaust port, which of course is open at this period, and the compression is thereby delayed until the piston has covered the auxiliary exhaust port.

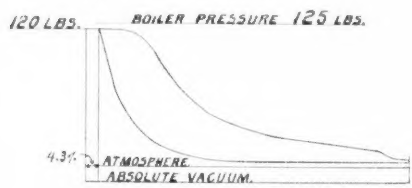


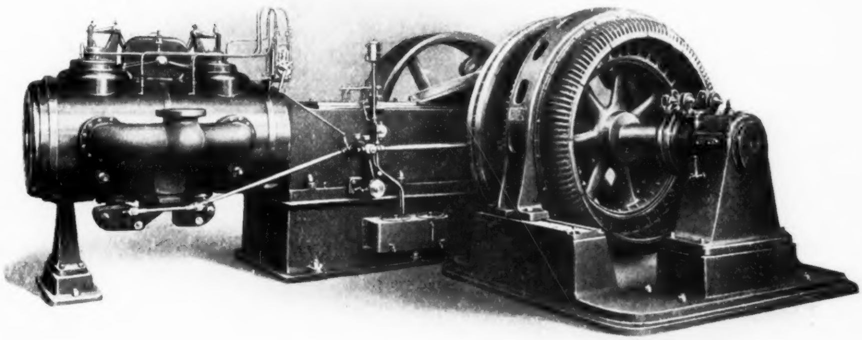
Figure 3

Fig. 3 gives a reproduction of an indicator diagram from a "Universal Unaflow" engine operating with three pounds back pressure, with a clearance of only 4.3 per cent. for a throttle pressure of 120 pounds. The delaying of the compression by means of the auxiliary exhaust port is shown in this diagram.

These auxiliary exhaust ports are located some distance from the hot heads of the cylinder and the hottest part of the cylinder walls, so that the trapped vapor cannot cool the heads and hot walls as it would if these ports were located at the ends of the cylinder, as in a counterflow engine.

These valves do not open until the exhaust has taken place through the central exhaust ports; consequently, they open under no difference in pressure on both sides of the valve. They do not close, moreover, until the piston itself has covered the auxiliary exhaust ports; and consequently, they close under no difference in pressure. They are, therefore, the only valves ever placed on a steam engine that open and close under equal pressures on both sides of the valve.

For this reason a double-heat



"The Universal Unaflow Engine"

balanced poppet valve is not necessary, as there is no strain on the valve gear in opening and closing the valves, and no balancing effect needs to be employed. These valves are driven by a compact cam gear operating in oil. Being of the single-beat type, these valves are, of course, steam-tight at all times.

When the engine is operating condensing, the auxiliary exhaust valves are automatically disengaged and remain closed at all times, unless the vacuum should break, whereupon the valves are automatically placed in operation, and the engine, consequently, again becomes a non-condensing small-clearance unaflow engine.

With both condensing and non-condensing conditions, therefore, this engine operates with small clearance; and that the unaflow principle is preserved under both conditions of operation is proven by the fact that the engine gives as good economy, in pounds of steam per i. h. p. hour, at one-fourth load as at full load, operating both condensing and non-condensing.

With saturated steam of only 140 pounds pressure, this engine has shown a steam consumption of 18.3 pounds per i. h. p. hour operating non-condensing, and 13 pounds when operating condensing; and with steam superheated 100 degrees F., the remarkable economy of 15.5 pounds has been obtained, operating non-condensing.

These are better economies than have ever been obtained from any other engine under these conditions of operation, and the performance is the more remarkable when it is remembered that the same engine, without any change whatever, can produce these economies under these different conditions.

It is the adaptability of this engine to operate and give the maximum economy under such widely varying conditions that led to the adoption of the name "*Universal* Unaflow."

The admission valves are of the double-beat poppet type, but are different from any other poppet valves yet designed, inasmuch as the seats of the valves automatically expand or contract to compensate for the expansion or contraction of the cylinder seats, due to differences in steam temperatures; and these

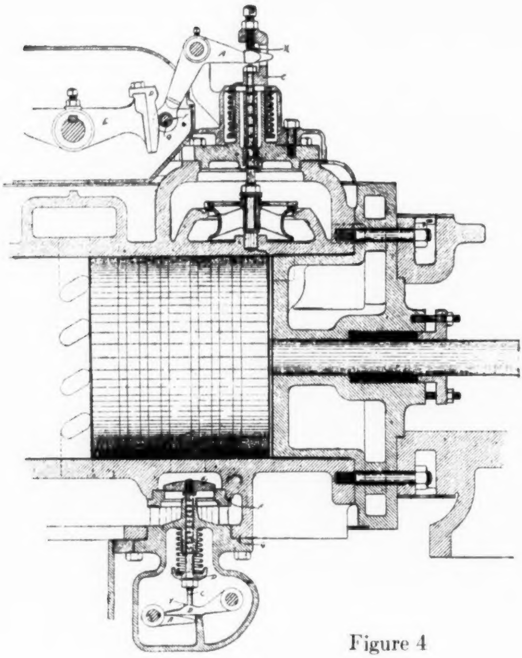


Figure 4

valves are steam-tight under all conditions. The admission valves are actuated by a cam gear, operating in oil; and water-groove or labyrinth packing is used on all valve stems.

Fig. 4 shows a cross-section of one end of the cylinder, and shows the construction of the admission and auxiliary exhaust valve-gears.

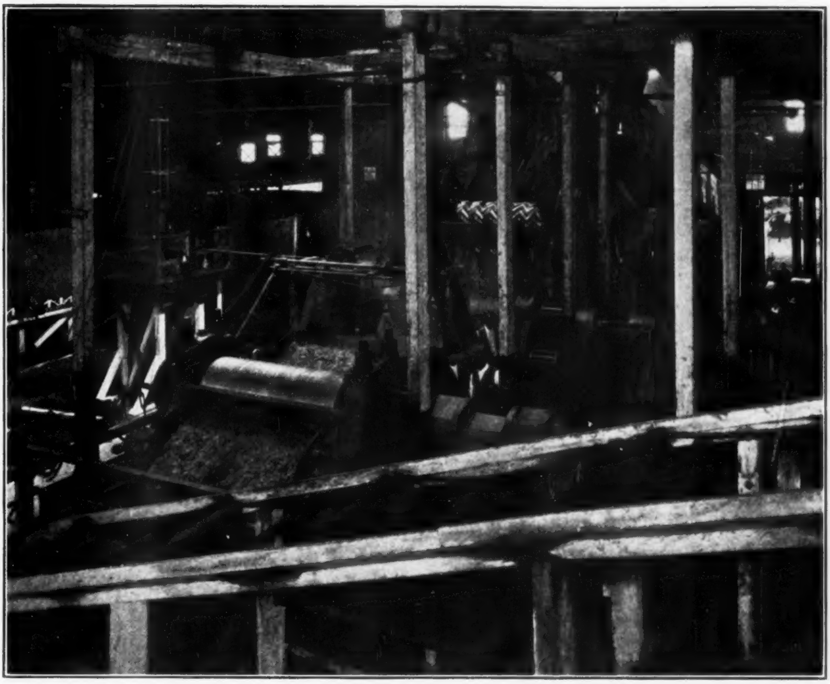
There are approximately 100,000 horsepower of "Universal Unaflow" engines in operation and on order. Many of these engines have replaced well-known designs of counterflow engines, and have shown a marked increase in economy.

LUBRICATION OF SUGARHOUSE MACHINERY

By T. L. Morris
Engineer, The Texas Oil Company, New Orleans

SUGAR CANE was introduced into Louisiana by the Jesuit Fathers in 1751. The first experiment resulted in failure and the industry was not revived until 1794, when Boré announced the discovery of a process of alkali and lime for neutralizing the free acids of cane syrup which produced an almost chemically pure granulated sugar. New life was given to the cultivation of cane, and in 1821 the first steam-driven mill was erected. This was equipped with evaporation kettles, replaced by vacuum pans in 1830, bone black being used for clarifying purposes. Rillieux, a native of Louisiana, in 1846 invented a system of utilizing the hot vapor from one vessel of boiling cane juice to evaporate the water in a second vessel, and from this discovery sprang the elaborate system of evaporation now in use.

The cost of sugarhouse machinery (exclusive of buildings) is estimated at approximately $250.00 per ton of cane crushed per 24 hour day. In other words, the cost of installing a plant of 1,000 ton capacity would be $250,000.00. This yield under the old system was approximately 2½ per cent., or 50 pounds of sugar per ton of cane. Under the modern system, the yield is approximately 8 per cent., or 160 pounds of sugar per ton of cane. The old method of using bone black for clarifying



Interior of a Louisiana Sugar Mill
Texaco Lubricants used throughout. Crater Compound on the gears

purposes has been replaced by the injection of sulphurous gas for bleaching and rendering antiseptic.

The equipment in all of the large plants is practically the same, including Corliss and other engines driving rollers, and crushers, operated by many gears, effect pans, air compressors, vacuum pumps, circulating pumps, syrup pumps, juice pumps, filter presses, and boiler feed pumps.

Regarding lubrication, the most important factors are,—the quality of the oil used and the selection of the proper oil to meet existing conditions. An oil must be selected which has been proven to be suitable for this use. The grinding season is tense and the mills operate continuously under a heavy strain from the day operation begins. There is no time to spare for tests or experiments. When an oil is put in use, the operators must know beyond the question of a doubt that it will hold up under the strain. Failure would mean suspension of operation and entail material damage to the owner.

In most plants the conditions demand the use of a high grade cylinder oil, such as Texaco Zenith Valve Oil or Pinnacle Cylinder Oil. However, there are plants where the steam conditions are such that Nabob Cylinder Oil or Draco Cylinder Oil can be used with entire satisfaction, but in the large plants with high steam pressures, where the engines work under heavy loads, Zenith Valve Oil and Pinnacle Cylinder Oil are the proper lubricants and by far the most economical.

The journals of the rollers and

crushers range in size from 14 inches to 20 inches in diameter and from 15 inches to 25 inches in length. The hydraulic pressure on these journals is very high and the friction great, necessitating the best grade of journal oil. The use of an inferior product would soon cause these journals to run hot, and might result in serious loss. This is a lubricating problem which has been solved by quality and is readily met by the use of Texaco Thuban Compound.

The lubrication of centrifugals is of material importance. Formerly it was believed impossible to use other than lard oil or sperm oil for this purpose, and even now some of the older engineers adhere to this idea. These oils have been successfully replaced in the large mills by Texaco Canopus Oil, a light bodied pure mineral oil of highest quality, equal or superior in every respect to the animal oils mentioned.

Texaco Hydra Oil is manufactured especially for hydraulic use and has been found to meet every requirement.

Now that we have briefly dealt with the lubrication of the most important machinery, the question arises,—What are we going to do to save the big gears, reduce the friction and wear, preserve the gear, and furnish lubrication, with the use of one product? "Texaco Crater Compound" is an eloquent answer. Crater Compound has been applied to every gear in some of the mills, and the performance of this product has been remarkable.

A careful study of the lubrication of sugarmill machinery has been made by the lubricating experts of The Texas Company in this country and abroad, and the products now furnished are gaining more recognition each year, due to the proper selection of high quality oils and the efficient and economical lubrication obtained from the use thereof.

LUBRICATION OF TRUCK AND TRACTOR ENGINES*

GENERALLY speaking the difficulty in lubricating tractor engines efficiently is second only to lubrication of racing engines. They are operating between the speed of maximum torque and maximum economy, a range in which the greatest heating occurs, which is directly responsible for most failures in tractor lubrication. What is true of tractor engines under 50 h.p. applies with equal weight to truck engines.

Lubricating systems for both services are no different than found in passenger-car service, with the exception that greater care must be taken to insure an abundance of oil at all times and to see that the system is such that if one point fails other parts will contribute oil to prevent sudden failure, but not sufficient for extended service.

To illustrate: One engine is equipped with a lubricating system that is so designed that if one connecting-rod pocket fails to get its oil, the adjacent rods supply enough to spread the development of a knock over two days time so

*Excerpt from "Truck and Tractor Engines—Part III," by H. L. Horning, Engineer and General Manager, Waukesha Motor Co., in "The Automobile," September 21, 1916, p. 480. From a paper read before the Society of Automobile Engineers at Milwaukee, September 1, 1916.

that it can be heard and corrected before full failure. Most oiling systems fail so quickly at one point that there is no chance to catch the failure in time. Truck engine bearings fail for lack of proper oil and from the above cause. Successful lubrication of heavy-duty engines imposes two functions on the oil.

First, to make an oil film between wearing surfaces.

Second, to act as a conveyor of heat. As a duty of an engine increases it is hard to tell which is the most important. The writer thoroughly believes in the great benefit derived from a large quantity of oil washing the heat from the lower part of the cylinders and crankcase into the lower pan, where design should promote dissipation of this collected heat.

The importance of an abundant screen area for very thoroughly straining the oil becomes of great importance in heavy-duty work. Geared oil pumps have been found to be the most satisfactory and dependable in service; the only points where they fail is in leakage of oil, both internal and external, and being not sufficiently large for the service.

Proper lubricating oil for heavy service seems to be one important insurance for long life.

The following general classification of oils manufactured by leading oil companies seems to fit the requirements and is given here rather than a scientific statement of oil characteristics. Oil companies produce oils graded as follows:

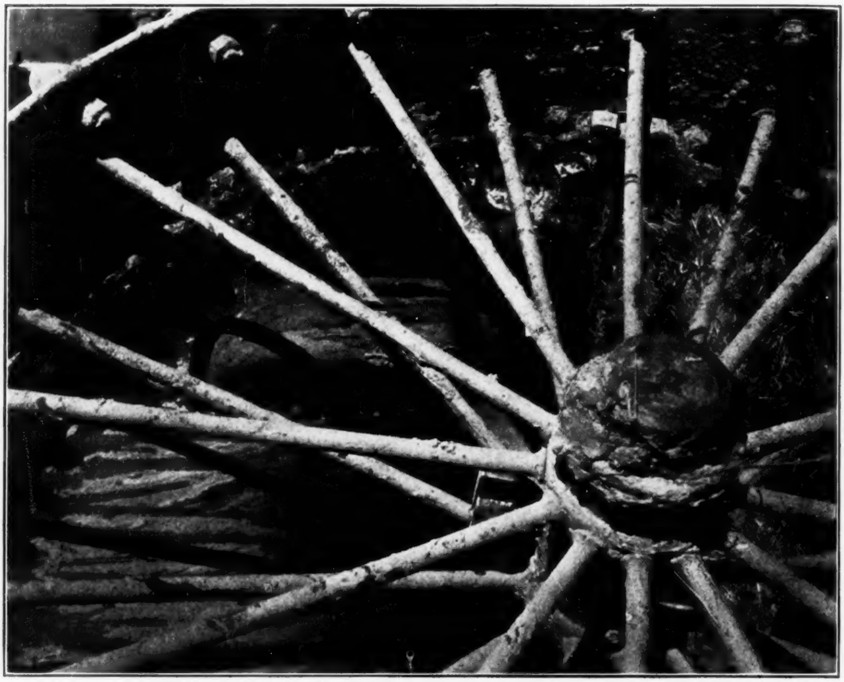
Light
Medium
Heavy
Extra Heavy.

Whereas most automobile engines will thrive on light oil, truck engines require medium and tractor engines require medium-heavy and extra-heavy. Truck engines run well in winter on light oil and operate best in summer on medium. Some tractor engines operate in winter, spring and fall on medium, and in summer, heavy oil. These are the smaller tractor engines which do not have the piston clearance nor do they get as hot generally as the large engines which operate in winter, early fall and late spring on medium, and summers on heavy or even extra heavy.

In burning gasoline, engines do not usually get as hot as when burning distillate or kerosene. If an engine operates well at any one season on one grade or weight of oil while burning gasoline, it will operate better with a heavier oil burning kerosene. Full force-feed systems can use heavier grades of oils than splash systems.

There is still another reason for heavier grades of oils in tractor service or when burning kerosene which has been mentioned before under crankshaft specifications, namely the dilution of the crankcase oil due to loss of mixture past the rings. Two days service using the same lubricating oil while burning either gasoline or kerosene will result in heavy dilution of the crankcase oil.

One instance comes to the writer's mind in which, after a days run, there was a greater quantity of oil and kerosene in the case at the end of the day than in the morning. In gasoline engines the gasoline evaporates under the best conditions of operation, while kerosene remains. Ten days service with kerosene without complete change of oil will bring the power of an engine down twenty per cent. In hot weather, the drop will be greater. Frequent renewal of oil or boiling off the lighter constituents before mixing with other oil helps considerably.



Tractor Wheel, showing Gear Teeth lubricated with Crater Compound

CRATER COMPOUND FOR TRACTOR GEARS

AFTER one of the Tractor Meets held at Madison, Wisconsin, for the demonstration of tractor plowing, we were afforded a very fine opportunity to see how Crater Compound stands up under water and mud conditions. A very severe rain storm was encountered during this demonstration and naturally the bull and pinion gears, as well as the traction wheels, were one mass of muddy clay with no visible signs of Crater Compound; yet, upon removing the mud with a knife blade, a very good film of Crater was found. This brings out clearly the suitability of Crater Compound for gear lubrication, as most favorable results have been obtained under extreme dust, water and mud conditions during the eight tractor demonstrations. The same tractor was used in all of these demonstrations, traveling sixty-four miles on the road and plowing a total of two hundred acres, during which time sixteen pounds of Crater was used. Previous records, conservatively estimated, show for the same work a consumption of forty-eight pounds of the grease formerly used. Crater Compound effected a saving of sixty per cent. The man in charge of this tractor was very well pleased with the results obtained with this lubricant, and stated to our representative that it would take a hatchet to get Crater away from him.